Reservoir Releases Improvements

Aeration Systems Annual Report 2004

TVA

Contents

Reservoir Releases Improvements

Aeration Systems Annual Report 2004

Program Goals and Objectives

The TVA Board of Directors approved the recommendations of the Lake Improvement Plan in February 1991. One of the commitments of the Plan was to improve the quality of releases at 16 TVA dams within a five-year period by increasing dissolved oxygen (DO) levels. DO level improvement is achieved by the use of various aeration systems to meet the established DO targets listed in Attachment I.

Following the signing of the Record of Decision for the Reservoir Operations Study (ROS), a comprehensive review of TVA's policies for managing the Tennessee River system, TVA is installing additional equipment to ensure that DO targets continue to be met.

System Descriptions

Aeration systems have been installed at Apalachia, Blue Ridge, Boone, Chatuge, Cherokee, Douglas, Fontana, Fort Loudoun, Hiwassee, Norris, Nottely, South Holston, Tims Ford, Watauga, and Watts Bar Dams. The DO levels at the remaining dam, Fort Patrick Henry, are improved through the operation of the aeration system at Boone Dam.

Aeration systems consist of oxygen injection, surface water pumps, aeration weirs, air compressors and blowers, and turbine venting. The use of unit preference at some dams enhances aeration efforts. Some projects require the use of multiple systems to attain desired results. The following table shows the various systems that have been implemented at each dam.

System	Dam
Oxygen Injection	Blue Ridge, Cherokee, Douglas, Fort Loudoun, Hiwassee, Tims Ford, Watts Bar
Surface Water Pumps	Cherokee, Douglas
Aeration Weirs	Chatuge, South Holston, Norris*
Air Compressors and Blowers	Nottely, Tims Ford
Turbine Venting	Apalachia, Boone, Cherokee, Douglas, Fontana, Hiwassee, Norris, South Holston, Watauga

**The intended use of Norris weir is for minimum flow; however, incidental aeration also is achieved.*

System Operations

The duration of aeration system operations varies from site to site. Typically, operations begin in mid-spring to early summer and end in late summer to early winter. Climatic and hydrologic conditions influence aeration system operations and can vary greatly from year to year. A summary of CY 2004, CY 2003, CY 2002, CY 2001, and CY 2000 aeration system operations for each project is provided in Attachments II, III, IV, V, and VI, respectively.

DO monitoring was conducted on a normal schedule during FY 2004, as described in Attachment VII.

Hardware, Software, and Communications Improvements

Improvements to RRI network systems and RRI enhancements resulting from the Reservoir Operations Study implemented during FY 2004 are listed below.

Blue Ridge

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring and control equipment for both the oxygen supply system and the downstream DO monitoring system. This was required by Information Services (IS) to continue remote operation.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.

Cherokee

O&M work

- Removed and replaced downstream DO monitoring system because of flooding in May 2004.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.
- Began fabrication and assembly of the oxygen supply monitoring and control system data acquisition panels and communication equipment.

Douglas

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring and control equipment for both the oxygen supply system and the downstream DO monitoring system. This was required by IS to continue remote operation.
- Removed and replaced downstream DO monitoring system because of flooding in May 2004.
- Upgraded the communication system in the head gallery gate for acquisition of surface-water-pump data to fiber-optic cable.
- Developed procedures and installed and tested software needed to remotely operate the oxygen supply system.
- Operated the oxygen supply system remotely from the River Forecast Center using WaterView.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.

Fort Loudoun

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring and control equipment for both the oxygen supply system and the downstream DO monitoring system. This was required by IS to continue remote operation.
- Installed remote valve control and monitoring electronics at the oxygen pad.
- Operated the oxygen supply system remotely from the River Forecast Center using WaterView.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.

Hiwassee

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring and control equipment for both the oxygen supply system and the downstream DO monitoring system. This was required by IS to continue remote operation.
- Developed procedures and installed and tested software needed to remotely operate the oxygen supply system.
- Operated the oxygen supply system remotely from River Forecast Center using WaterView.

Norris

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring and control equipment for the downstream DO monitoring system. This was required by IS to continue remote operation.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for oxygen supply system.

Nottely

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring equipment for the downstream DO monitoring system. This was required by IS to continue remote operation.
- Specified, purchased, and performed preliminary tests of a new air flowmeter for the new aerating blowers.
- Performed GPS mapping of diffuser lines for installation and maintenance purposes.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.

Tims Ford

O&M work:

- Modified operation of the oxygen pad supply system to prevent accidental interruption of the oxygen supply to the header.
- Specified, purchased, and performed preliminary tests of a new oxygen mass flowmeter for the penstock oxygen supply system.

RRI enhancements:

- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.

Watts Bar

O&M work:

- Performed network re-architecture and reconfiguration of the monitoring and control equipment for both the oxygen supply system and the taildeck DO monitoring system. This was required by IS to continue remote operation.

- Added two new LOX line aeration control drops.
- Developed procedures and installed and tested software needed to remotely operate the oxygen supply system.
- Operated the oxygen supply system remotely from River Forecast Center using WaterView.
- Moved and upgraded the taildeck DO monitoring system when the damaged taildeck stilling wells were replaced.
- Performed GPS mapping of diffuser lines for installation and maintenance purposes.

RRI enhancements:
- Performed design work on the network based monitoring and control systems to be installed for the oxygen supply system.
- Began fabrication and assembly of the oxygen supply monitoring and control system data acquisition panels and communication equipment.

Emergency Minimum Flow System (EMFS) Monitoring at Chatuge

O&M work:
- Designed, installed, and operated the new weir level monitoring system during the FY04 outage. The system provided a radio system to transmit the weir pool elevation to the EMFS monitoring system during outages.
- Installed a telephone system that was used during EMFS deployment.
- Performed network reconfiguration of the EMFS system required by IS for continued operation of the EMFS.

Physical Modifications and Improvements

Improvements to the physical operations of RRI systems and RRI enhancements resulting from the Reservoir Operations Study implemented during FY 2004 are listed below.

Apalachia

O&M work:
- Fabricated Venturi assembly to increase air flow through the turbine shaft.

Blue Ridge

O&M work:
- Operated the EMFS during the 2003 unit outage (from 11/13/03 - 11/26/03).
- Rebuilt the pressure regulators.
- Cleaned the exterior of the oxygen tank.
- Conducted a technical walkdown of the oxygen system and prepared a list of findings.

Boone

O&M work:
- Fabricated Venturi assembly to increase air flow through the turbine shaft.

Chatuge

O&M work:
- Operated the EMFS during the 2004 unit outage (from 2/4/04 - 6/14/04).
- Cleaned and inspected the weir pipes during the fall and spring to help maintain minimum flow.
- Performed weir pool bank stabilization.

- Replaced weir buoy barricade.
- Repaired damaged weir valves during the unit outage.

Cherokee

O&M work:
- Cleaned the exterior of the oxygen tank.
- Rebuilt the pressure regulators.
- Conducted a technical walkdown of the oxygen system and prepared a list of findings.
- Inspected the surface water pumps and made suggestions for future maintenance activities.
- Performed additional monitoring in support of Reservoir Operations Study Biological Opinion Requirements, Task 1.
- Replaced five oxygen diffuser lines.
- Installed oxygen pad access security gate bollards.

RRI enhancements:
- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram (P&ID) drawings for the oxygen supply system.
- Prepared and released civil, electrical and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway, and installation of new security fencing.
- Designed and fabricated a new oxygen distribution header.
- Fabricated and installed 6,000 feet of new diffuser lines.

Douglas

O&M work:
- Cleaned the exterior of the oxygen tank.
- Conducted a technical walkdown of the oxygen system and prepared a list of findings.
- Identified diffuser line locations.
- Corrected problem with defective switching valve in the relief valve tree.
- Corrected vaporizer bank switching panel malfunction.
- Inspected the surface water pumps and made suggestions for future maintenance activities.

RRI enhancements:
- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.
- Prepared and released civil, electrical and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway, and installation of new security fencing.

Fort Loudoun

O&M work:
- Cleaned the exterior of the oxygen tank.
- Conducted a technical walkdown of the oxygen system and prepared a list of findings.
- Obtained GPS coordinates for the diffuser lines.

- Installed a pressure gauge on the buoyancy line pressure regulator.
- Corrected problem with inoperable diffuser line MOV.
- Repaired a damaged diffuser line.
- Shortened one diffuser line and used the remaining section to lengthen another one.

RRI enhancements:
- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.
- Prepared and released civil, electrical and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required, installation of embedded conduit, pouring concrete pad, tank piers, roadway, and installation of new security fencing.

Hiwassee

O&M work:
- Cleaned the exterior of the oxygen tank.
- Corrected problem with defective switching valve in the relief valve tree.
- Performed engineering evaluation and troubleshooting of broken/plugged diffuser supply lines.
- Fabricated and installed a new oxygen distribution header.
- Installed instrumentation to support remote operation of the oxygen supply system.

RRI enhancements:
- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.
- Designed, procured and installed larger capacity pressure build circuit equipment for the oxygen supply system.

Normandy

O&M work:
- Operated the aeration diffuser system from 4/5/04 – 11/24/04.
- Procured and installed a new parts storage building.

Norris

O&M work:
- Cleaned and inspected the weir pipes during the spring and fall to help maintain minimum flows.
- Completed weir bank stabilization.
- Replaced plexiglass cover on display on weir kiosk.

RRI enhancements:
- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.

Nottely

RRI enhancements:
- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.
- Designed, procured and installed larger capacity air blowers and related equipment for the air injection system.

South Holston

O&M work:

- Collected additional scrollcase grab samples to monitor potentially low DO from September to November.
- Cleaned and inspected the weir pipes during the spring and fall to help maintain minimum flow.
- Initiated modifications to the weir to change the weir minimum flow to 150 cubic feet per second.
- Fabricated and installed new trash racks at weir.

Tellico

O&M work:

- Operated the siphon from 4/26/04 – 10/22/04.

Tims Ford

O&M work:

- Cleaned the exterior of the oxygen tank.
- Rebuilt the pressure regulators.
- Conducted a technical walkdown of the oxygen system and prepared a list of findings.
- Performed the annual penstock inspection and made small repairs to the oxygen lines.
- Installed oxygen safety signs near the oxygen pad.
- Replaced broken bypass valve for large unit motor-operated valve.

RRI enhancements:

- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.

Watts Bar

O&M work:

- Cleaned the exterior of the oxygen tank.
- Conducted a technical walkdown of the oxygen system and prepared a list of findings.
- Fabricated and replaced Unit 1, 2, and 5 monitor stilling wells.

RRI enhancements:

- Issued Scope of Work document for the oxygenation system.
- Prepared Process and Instrumentation Diagram drawings for the oxygen supply system.
- Prepared and released civil, electrical and mechanical design drawings for the oxygen supply system enhancements.
- Performed civil site construction for the oxygen supply system enhancements. This included site preparation, demolition of existing features as required and installation of embedded conduit.
- Designed and fabricated a new oxygen distribution header.
- Fabricated and installed 16,000 feet of new diffuser lines at WBH.

Other

O&M work:

- Prepared boat with materials needed for quick response diffuser line repair.
- Provided assistance to the Reservoir Operations Study.

RRI enhancements:

- Performed technical investigations on the design and installation of oxygen supply systems.

- Awarded a contract for seven 21,000-gallon liquid oxygen tanks with an option to add up to four additional tanks.
- Prepared technical procurement specification for vaporizer subsystems and related components.
- Procured and received mechanical components for oxygen distribution header fabrication.
- Procured and received instrumentation and controls components for the fabrication of oxygen supply system monitoring and control systems.
- Procured and received piping and related components for the fabrication of oxygen supply and diffuser lines.

System Performance

Oxygen Usage - Almost 19,750 tons of liquid oxygen were used during FY 2004 at a cost of approximately $1,816,500. The price of liquid oxygen was $90 per ton. Plant-by-plant LOx usages and costs are depicted in Attachments VIII and IX, and month-by-month usage for each plant is summarized in Attachment X.

FY 2004 Performance Measures - The DO deficit due to forced outage (the amount of time dissolved oxygen levels in dam releases were below target due to a forced outage) decreased from 20.1 mg/L deficit days in FY 2003 to 2.0 mg/L deficit days in FY 2004.

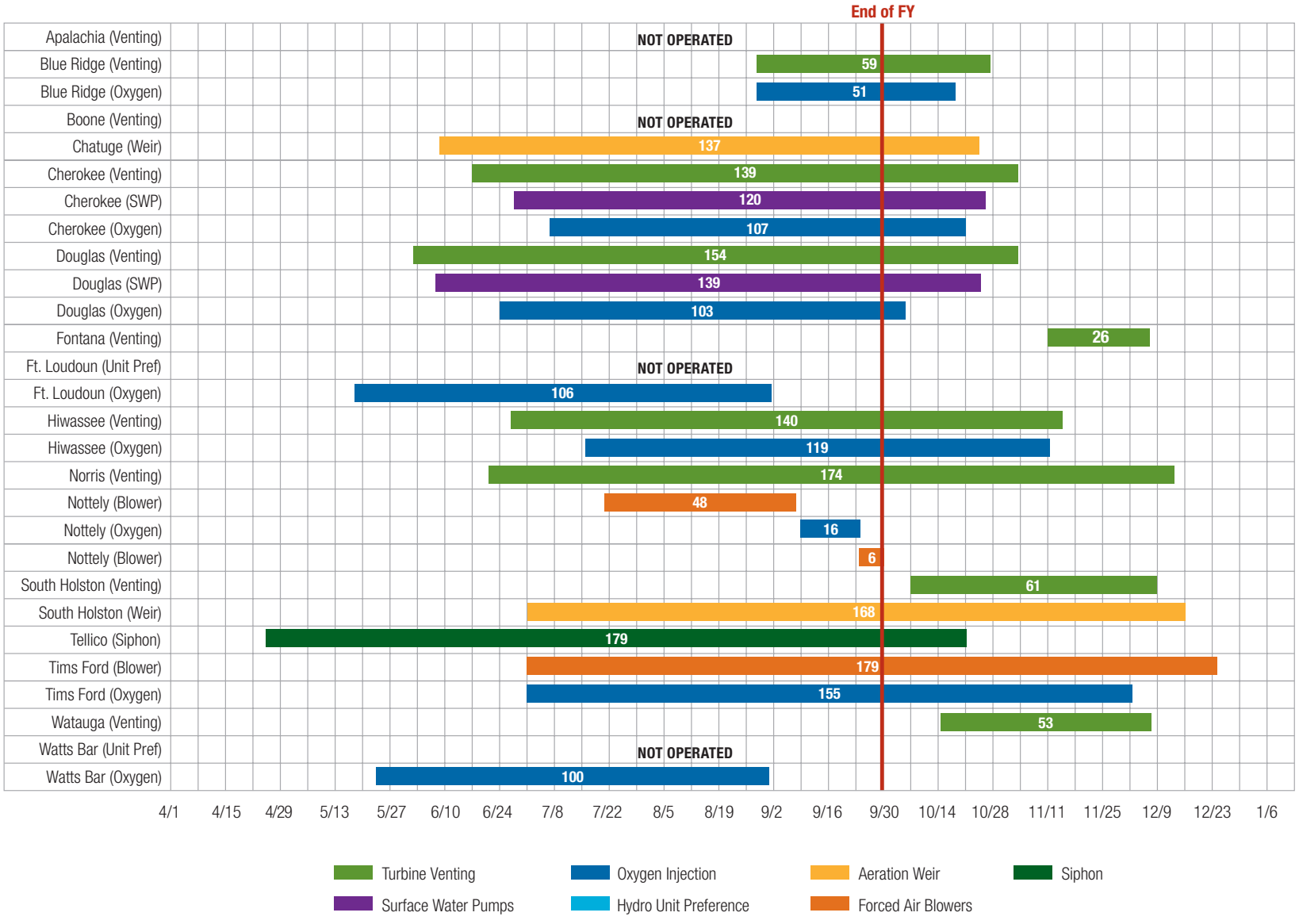
FY 2004 performance is summarized in Attachment XI (FY 2004 Performance Measure Chart), Attachment XII (FY 2004 Aeration Systems Availability), and Attachment XIII (FY 2004 Aeration Systems Outage Reports). The FY 2003 Performance Measure Chart is included as Attachment XIV.

ATTACHMENT I

Dissolved Oxygen Targets by Project

Project	DO Target (mg/L)	Aeration System Component
Apalachia	6	Turbine venting
Blue Ridge	6	Forebay oxygen injection
Boone	4	Turbine venting
Chatuge	4	Aeration weir
Cherokee	4	Turbine venting, surface water pumps, forebay oxygen injection
Douglas	4	Turbine venting, surface water pumps, forebay oxygen injection
Fontana	6	Turbine venting
Fort Loudoun	4	Forebay oxygen injection
Fort Patrick Henry	4	Upstream improvements
Hiwassee	6	Forebay oxygen injection
Norris	6	Turbine venting
Nottely	4	Turbine air injection
South Holston	6	Turbine venting and aeration weir
Tims Ford	6	Turbine air injection and penstock oxygen injection
Watauga	6	Turbine venting
Watts Bar	4	Forebay oxygen injection

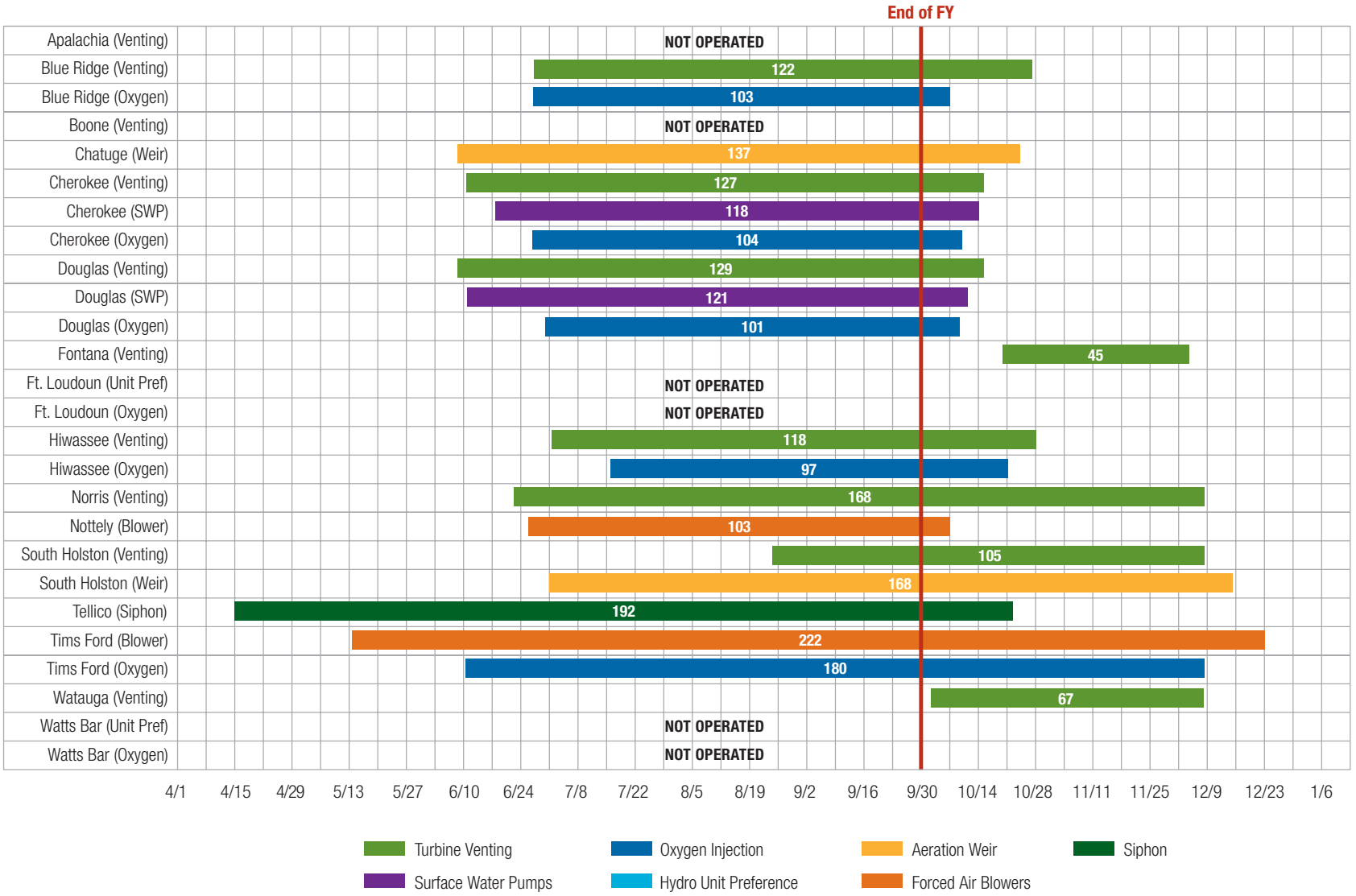
ATTACHMENT II-A
Summary of RRI Operations for CY 2004



ATTACHMENT II-B
Summary of RRI Operations for CY 2004

Project	Start Date	Duration	End Date
Apalachia (Venting)		0	Not Operated
Blue Ridge (Venting)	29-Aug	59	27-Oct
Blue Ridge (Oxygen)	29-Aug	51	19-Oct
Boone (Venting)		0	Not Operated
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	17-Jun	139	3-Nov
Cherokee (SWP)	28-Jun	120	26-Oct
Cherokee (Oxygen)	6-Jul	107	21-Oct
Douglas (Venting)	2-Jun	154	3-Nov
Douglas (SWP)	8-Jun	139	25-Oct
Douglas (Oxygen)	24-Jun	103	5-Oct
Fontana (Venting)	11-Nov	26	7-Dec
Ft. Loudoun (Unit Pref)		0	Not Operated
Ft. Loudoun (Oxygen)	18-May	106	1-Sep
Hiwassee (Venting)	28-Jun	140	15-Nov
Hiwassee (Oxygen)	16-Jul	119	12-Nov
Norris (Venting)	22-Jun	174	13-Dec
Nottely (Blower)	21-Jul	48	7-Sep
Nottely (Oxygen)	8-Sep	16	24-Sep
Nottely (Blower)	24-Sep	6	30-Sep
South Holston (Venting)	7-Oct	61	7-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	26-Apr	179	22-Oct
Tims Ford (Blower)	1-Jul	179	27-Dec
Tims Ford (Oxygen)	1-Jul	155	3-Dec
Watauga (Venting)	15-Oct	53	7-Dec
Watts Bar (Unit Pref)		0	Not Operated
Watts Bar (Oxygen)	24-May	100	1-Sep

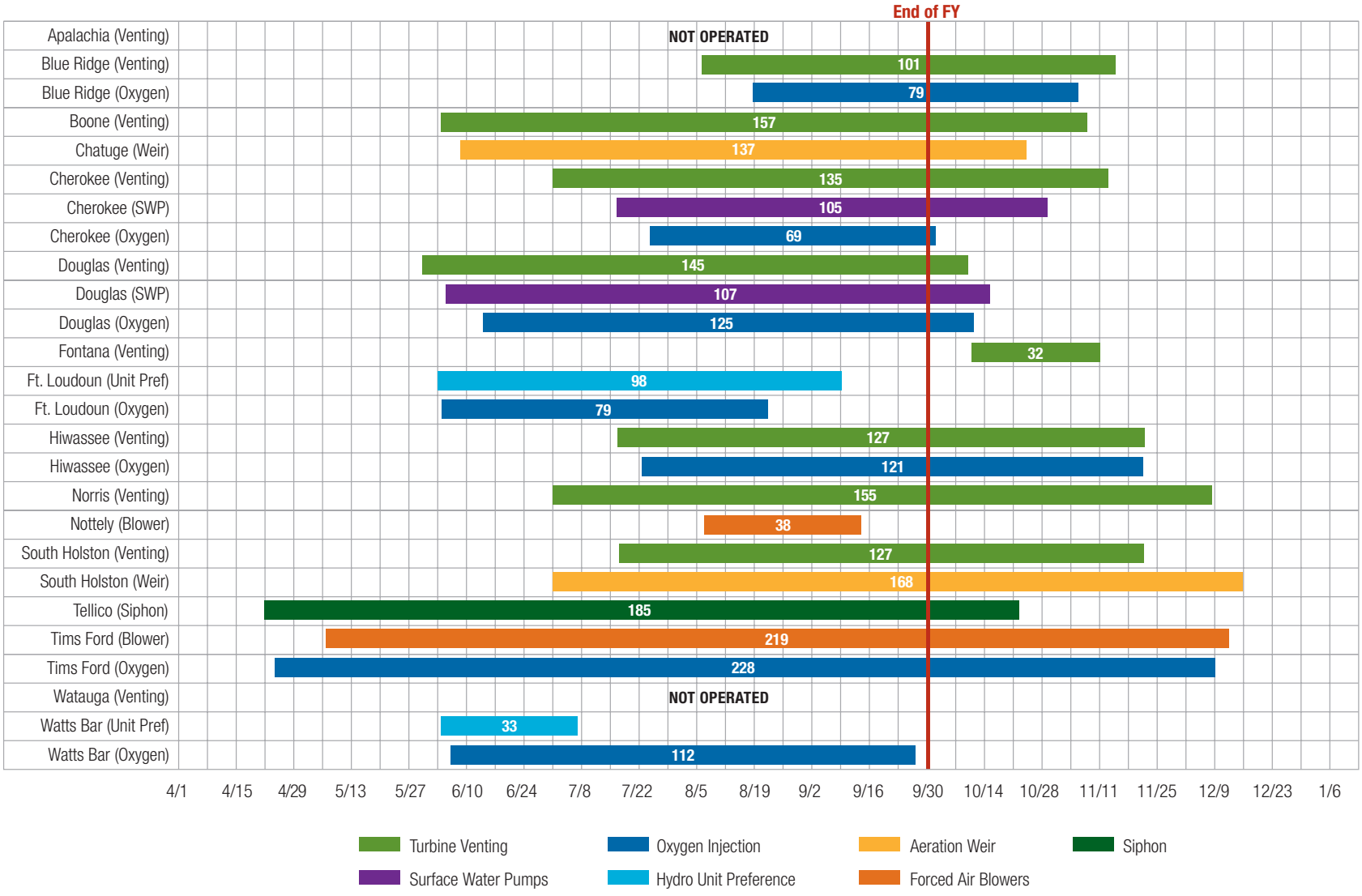
ATTACHMENT III-A
Summary of RRI Operations for CY 2003



ATTACHMENT III-B
Summary of RRI Operations for CY 2003

Project	Start Date	Duration	End Date
Apalachia (Venting)		0	Not Operated
Blue Ridge (Venting)	27-Jun	122	27-Oct
Blue Ridge (Oxygen)	27-Jun	103	8-Oct
Boone (Venting)		0	Not Operated
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	11-Jun	127	16-Oct
Cherokee (SWP)	18-Jun	118	14-Oct
Cherokee (Oxygen)	27-Jun	104	9-Oct
Douglas (Venting)	9-Jun	129	16-Oct
Douglas (SWP)	11-Jun	121	10-Oct
Douglas (Oxygen)	30-Jun	101	9-Oct
Fontana (Venting)	20-Oct	45	4-Dec
Ft. Loudoun (Unit Pref)		0	Not Operated
Ft. Loudoun (Oxygen)		0	Not Operated
Hiwassee (Venting)	2-Jul	118	28-Oct
Hiwassee (Oxygen)	16-Jul	97	21-Oct
Norris (Venting)	23-Jun	168	8-Dec
Nottely (Blower)	27-Jun	103	8-Oct
South Holston (Venting)	25-Aug	105	8-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	15-Apr	192	24-Oct
Tims Ford (Blower)	15-May	222	23-Dec
Tims Ford (Oxygen)	11-Jun	180	8-Dec
Watauga (Venting)	2-Oct	67	8-Dec
Watts Bar (Unit Pref)		0	Not Operated
Watts Bar (Oxygen)		0	Not Operated

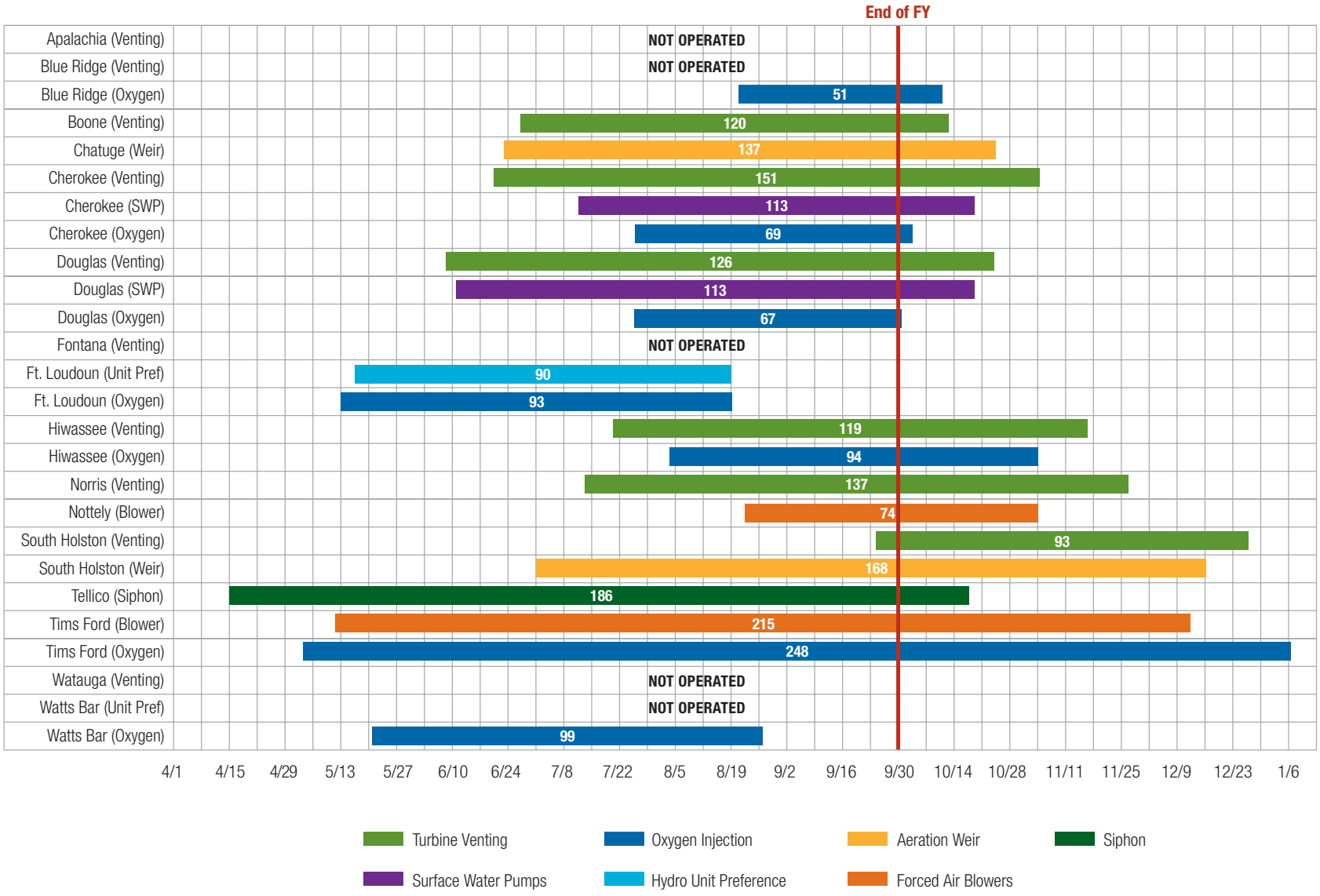
ATTACHMENT IV-A
Summary of RRI Operations for CY 2002



ATTACHMENT IV-B
Summary of RRI Operations for CY 2002

Project	Start Date	Duration	End Date
Apalachia (Venting)		0	
Blue Ridge (Venting)	6-Aug	101	15-Nov
Blue Ridge (Oxygen)	19-Aug	79	6-Nov
Boone (Venting)	4-Jun	157	8-Nov
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	1-Jul	135	13-Nov
Cherokee (SWP)	16-Jul	105	29-Oct
Cherokee (Oxygen)	25-Jul	69	2-Oct
Douglas (Venting)	30-May	145	22-Oct
Douglas (SWP)	5-Jun	107	20-Sep
Douglas (Oxygen)	14-Jun	125	17-Oct
Fontana (Venting)	11-Oct	32	12-Nov
Ft. Loudoun (Unit Pref)	3-Jun	98	9-Sep
Ft. Loudoun (Oxygen)	4-Jun	79	22-Aug
Hiwassee (Venting)	17-Jul	127	21-Nov
Hiwassee (Oxygen)	23-Jul	121	21-Nov
Norris (Venting)	1-Jul	155	3-Dec
Nottely (Blower)	7-Aug	38	14-Sep
South Holston (Venting)	17-Jul	127	21-Nov
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	22-Apr	185	24-Oct
Tims Ford (Blower)	7-May	219	12-Dec
Tims Ford (Oxygen)	25-Apr	228	9-Dec
Watauga (Venting)		0	
Watts Bar (Unit Pref)	4-Jun	33	7-Jul
Watts Bar (Oxygen)	6-Jun	112	26-Sep

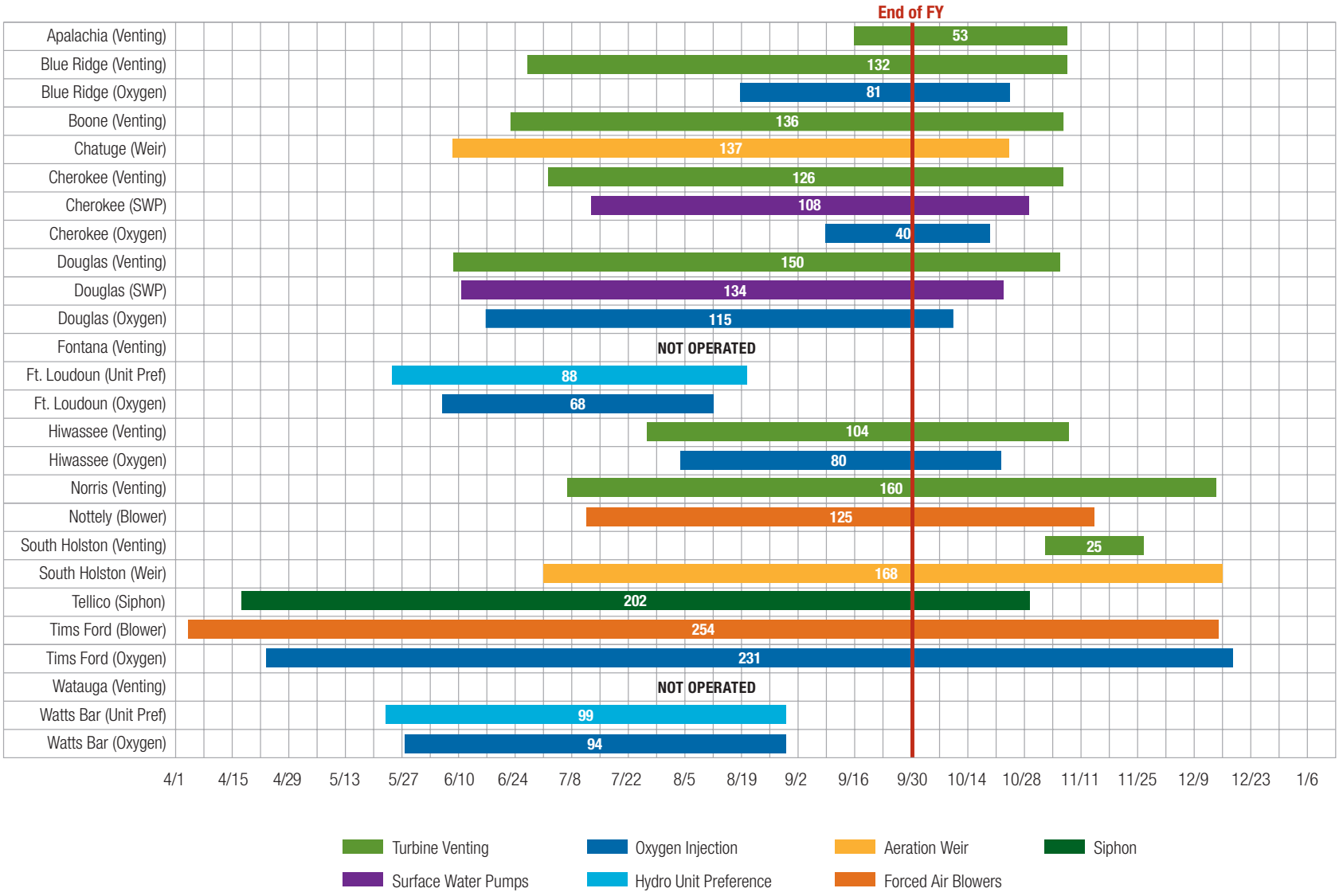
ATTACHMENT V-A
Summary of RRI Operations for CY 2001



ATTACHMENT V-B
Summary of RRI Operations for CY 2001

Project	Start Date	Duration	End Date
Apalachia (Venting)		0	
Blue Ridge (Venting)		0	
Blue Ridge (Oxygen)	21-Aug	51	11-Oct
Boone (Venting)	14-Jun	120	12-Oct
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	7-Jun	151	5-Nov
Cherokee (SWP)	28-Jun	113	19-Oct
Cherokee (Oxygen)	26-Jul	69	3-Oct
Douglas (Venting)	20-Jun	126	24-Oct
Douglas (SWP)	28-Jun	113	19-Oct
Douglas (Oxygen)	26-Jul	67	1-Oct
Fontana (Venting)		0	
Ft. Loudoun (Unit Pref)	23-May	90	21-Aug
Ft. Loudoun (Oxygen)	20-May	93	21-Aug
Hiwassee (Venting)	20-Jul	119	16-Nov
Hiwassee (Oxygen)	3-Aug	94	5-Nov
Norris (Venting)	13-Jul	137	27-Nov
Nottely (Blower)	23-Aug	74	5-Nov
South Holston (Venting)	25-Sep	93	27-Dec
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	15-Apr	186	18-Oct
Tims Ford (Blower)	11-May	215	12-Dec
Tims Ford (Oxygen)	4-May	248	7-Jan
Watauga (Venting)		0	
Watts Bar (Unit Pref)		0	
Watts Bar (Oxygen)	21-May	99	28-Aug

ATTACHMENT VI-A
Summary of RRI Operations for CY 2000



ATTACHMENT VI-B
Summary of RRI Operations for CY 2000

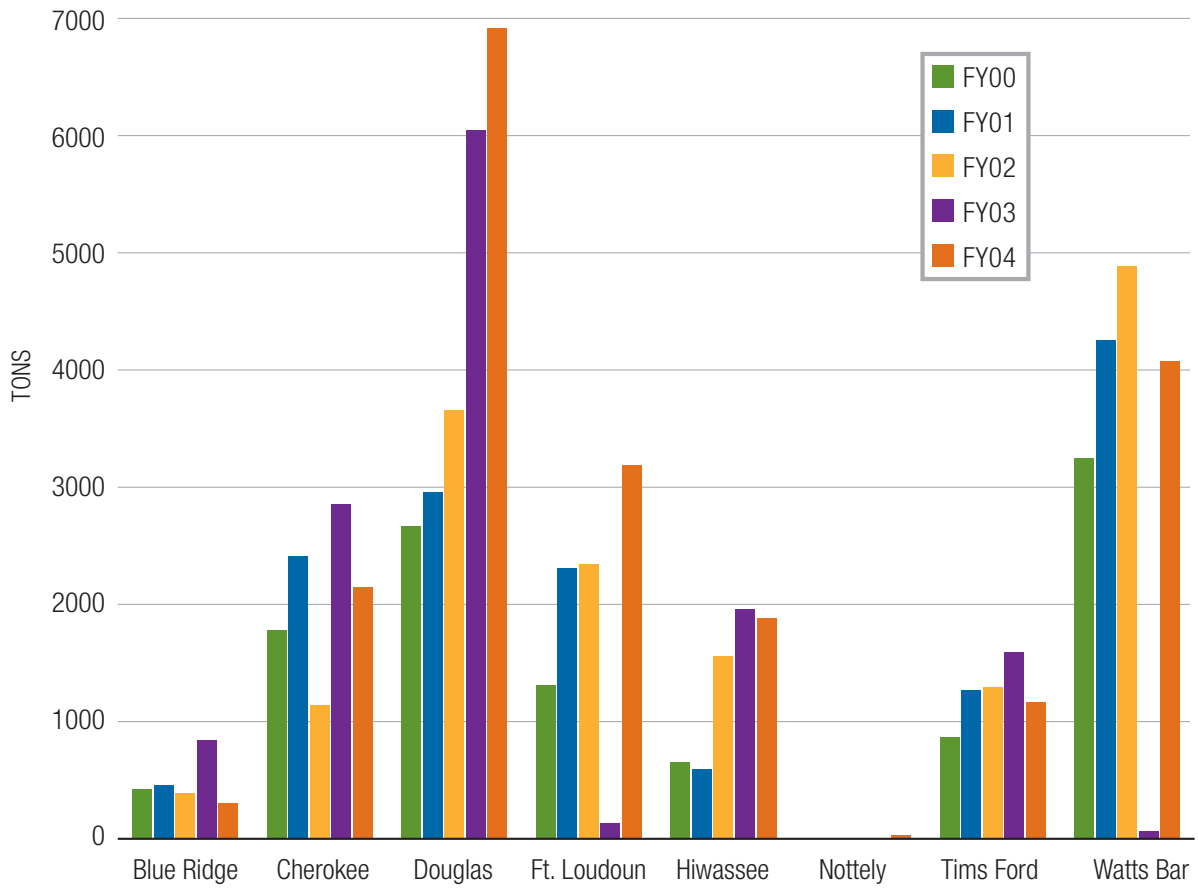
Project	Start Date	Duration	End Date
Apalachia (Venting)	15-Sep	53	7-Nov
Blue Ridge (Venting)	28-Jun	132	7-Nov
Blue Ridge (Oxygen)	4-Aug	81	24-Oct
Boone (Venting)	23-Jun	136	6-Nov
Chatuge (Weir)	9-Jun	137	24-Oct
Cherokee (Venting)	3-Jul	126	6-Nov
Cherokee (SWP)	14-Jul	108	30-Oct
Cherokee (Oxygen)	9-Sep	40	19-Oct
Douglas (Venting)	9-Jun	150	6-Nov
Douglas (SWP)	11-Jun	134	23-Oct
Douglas (Oxygen)	17-Jun	115	10-Oct
Fontana (Venting)		0	
Ft. Loudoun (Unit Pref)	25-May	88	21-Aug
Ft. Loudoun (Oxygen)	6-Jun	68	13-Aug
Hiwassee (Venting)	27-Jul	104	8-Nov
Hiwassee (Oxygen)	4-Aug	80	23-Oct
Norris (Venting)	7-Jul	160	14-Dec
Nottely (Blower)	12-Jul	125	14-Nov
South Holston (Venting)	2-Nov	25	27-Nov
South Holston (Weir)	1-Jul	168	16-Dec
Tellico (Siphon)	18-Apr	202	6-Nov
Tims Ford (Blower)	5-Apr	254	15-Dec
Tims Ford (Oxygen)	1-May	231	18-Dec
Watauga (Venting)		0	
Watts Bar (Unit Pref)	23-May	99	30-Aug
Watts Bar (Oxygen)	28-May	94	30-Aug

ATTACHMENT VII
FY 2004 Monitoring Schedule

Project/Location	No. Units	Target DO (mg/L)	Monitoring Start Date	Estimated Monitoring End Date	Type Monitoring	Frequency	Parameters	Special Parameters
APALACHIA-RRI	2	6.0	06-30-04	11-01-04				
Penstock/unit					Grab	Biweekly	DO, T	
Taildeck/unit					Grab	Biweekly	DO, T	TDG
BLUE RIDGE-RRI	1	6.0	06-15-04	11-01-04				
Scrollcase/unit					Grab	Weekly	DO, T	
Taildeck/unit					Cont (Hydrolab)	15 min.	DO, T	
BOONE-RRI	3	4.0	05-15-04	11-15-04				
Scrollcase/unit					Grab	Biweekly	DO, T	
Taildeck/unit					Grab	Biweekly	DO, T	
CHATUGE-RRI	1	4.0	06-15-04	10-15-04				
Scrollcase					Grab	Biweekly	DO, T	
Weir (above/below, during gen.)					Grab	Biweekly	DO, T	TDG
CHEROKEE-RRI	4	4.0	05-15-04	10-20-04				
Reservoir (1 station - Forebay)					Profile	Monthly (May - Sept)	Hydrolab	pH, conductivity
Scrollcase (unit 1 and 4)					Grab	Weekly	DO, T	
Downstream (2000 ft.)					Cont (Hydrolab)	15 min.	DO, T	TDG
DOUGLAS-RRI	4	4.0	05-15-04	10-23-04				
Reservoir (1 station - Forebay)					Profile	Monthly (May - Sept)	Hydrolab	pH, conductivity
Scrollcase (unit 1 and 4)					Grab	Weekly	DO, T	
Downstream (2500 ft.)					Cont (Hydrolab)	15 min.	DO, T	TDG
FONTANA-RRI	3	6.0	08-21-04	11-15-04				
Scrollcase/unit					Grab	Biweekly	DO, T	
Taildeck/unit					Grab	Biweekly	DO, T	TDG
FORT LOUDOUN-RRI	4	4.0	05-01-04	08-15-04				
Taildeck/unit					Grab	Weekly	DO, T	
Taildeck (unit 1 and 4)					Cont (Hydrolab)	15 min.	DO, T	TDG
FORT PATRICK HENRY-RRI	2	4.0	05-15-04	11-01-04				
Taildeck/unit					Grab	Biweekly	DO, T	
HIWASSEE-RRI	2	6.0	06-30-04	11-15-04				
Scrollcase/unit					Grab	Weekly	DO, T	
Downstream (1200 ft., left bank)					Cont (Hydrolab)	15 min.	DO, T	
NORMANDY-RRI			08-01-04	10-31-04				
Downstream bridge					Grab	Biweekly	DO, T	
NORRIS-RRI	2	6.0	07-01-04	12-01-04				
Taildeck/unit					Grab	Weekly	DO, T	
Tailrace (left wing wall)					Cont (Hydrolab)	15 min	DO, T	
Canoe portage below weir					Grab	Weekly	DO, T	
Hwy 61 bridge					Grab	Weekly	DO, T	
NOTTELY-RRI	2	4.0	06-15-04	11-01-04				
Penstock/unit					Grab	Weekly	DO, T	
Downstream (1000 ft., right bank)					Cont (Hydrolab)	15 min.	DO, T	TDG
SOUTH HOLSTON-RRI	1	6.0	07-15-04	12-23-04				
Scrollcase					Grab	Biweekly	DO, T	
Taildeck					Grab	Biweekly	DO, T	
Downstream (bridge below weir)					Grab	Biweekly	DO, T	
Scrollcase					Grab	on request (Sep-Nov)	DO, T	If DO approaches 3.0 then collect weekly, if DO approaches 2.0 then collect twice/week.
TIMS FORD-RRI	2	6.0	04-15-04	12-21-04				
Taildeck/unit					Grab	Weekly	DO, T	
Scrollcase/unit					Grab	Weekly	DO, T	
Taildeck					Cont (Hydrolab)	15 min.	DO, T	TDG
WATAUGA-RRI	2	6.0	07-15-04	12-15-04				
Penstock/unit					Grab	Weekly	DO, T	
Taildeck/unit					Grab	Weekly	DO, T	
Wilbur (taildeck and below weir)					Grab	Weekly	DO, T	
WATTS BAR-RRI	5	4.0	05-01-04	09-01-04				
Taildeck/unit					Grab	Weekly	DO, T	
Taildeck (units 1, 2, and 5)					Cont (Hydrolab)	15 min.	DO, T	
WATTS BAR ENHANCE (Chickamauga)	4	4.0	04-01-04	10-31-04				
Reservoir (1 station - Forebay)					Profile	Weekly (April - Oct)	Hydrolab	pH, conductivity
Taildeck/unit					Grab	Weekly	DO, T	
Downstream bridge trestle					Cont (Hydrolab)	15 min.	DO, T	

ATTACHMENT VIII
Oxygen Usage by Plant

Plant	FY00	FY01	FY02	FY03	FY04	Average
Blue Ridge	424	455	390	839	306	483
Cherokee	1782	2410	1135	2857	2149	2067
Douglas	2668	2955	3659	6042	6919	4449
Ft Loudoun	1313	2304	2340	128	3184	1854
Hiwassee	653	594	1555	1960	1882	1329
Nottely	0	0	0	0	31	6
Tims Ford	868	1265	1294	1595	1165	1237
Watts Bar	3243	4251	4881	63	4074	3302
TOTAL	**10951**	**14234**	**15254**	**13484**	**19710**	**14727**



Attachment VII: Costs by Plant

Business sensitive

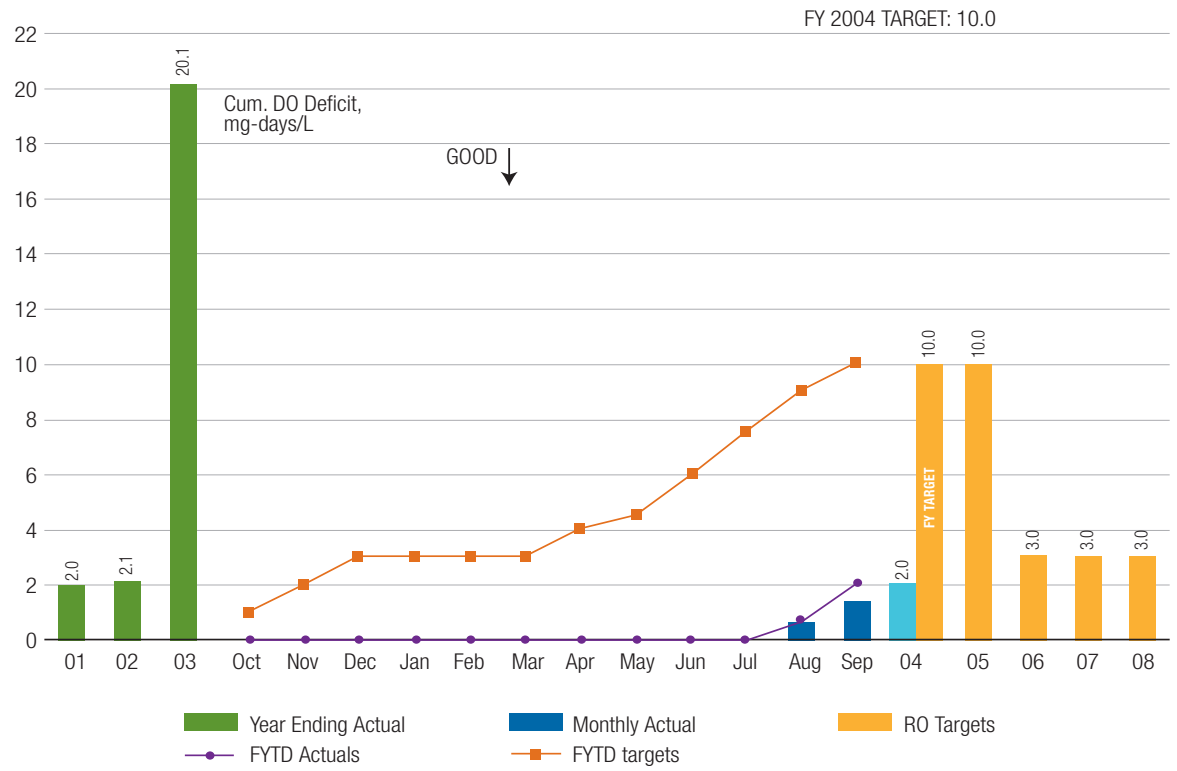
For cost information, contact: Chuck Bach (865-632-4203)

ATTACHMENT X
FY 2004 BOC Oxygen Tonnage Usage

Plant	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	TOTAL
Blue Ridge	66.50	0	0	0	0	0	0	0	0	0	43.14	196.61	306.25
Cherokee	224.08	0	22.46	0	0	0	0	0	45.17	611.12	710.01	536.57	2149.41
Douglas	598.26	22.31	0	0	0	23.82	0	46.79	204.04	1977.35	2041.17	2005.30	6919.04
Ft Loudoun	0	0	0	0	0	23.82	0	322.21	988.40	873.66	952.10	24.08	3184.27
Hiwassee	437.22	0	0	0	0	18.11	0	22.87	28.96	186.53	805.48	382.76	1881.93
Nottely	0	0	0	0	0	0	0	0	0	0	22.87	7.80	30.67
Tims Ford	261.74	256.76	13.47	0	0	0	18.23	0	0	200.71	178.29	235.75	1164.95
Watts Bar	0	0	24.77	0	0	21.53	47.53	261.60	1349.50	975.12	1150.57	243.00	4073.62
TOTAL	**1587.8**	**279.07**	**60.70**	**0**	**0**	**87.28**	**65.76**	**653.47**	**2616.07**	**4824.49**	**5903.63**	**3631.87**	**19710.14**

ATTACHMENT XI
FY 2004 Performance Measure Chart

DISSOLVED OXYGEN DEFICIT DUE TO FORCED OUTAGE - SEPTEMBER 2004



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
FYTD Actuals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	2.0
FYTD Targets	1.0	2.0	3.0	3.0	3.0	3.0	4.0	4.5	6.0	7.5	9.0	10.0

DEFINITION: For each of the 15 dams with aeration systems installed (16 tailwaters actually benefit), a planned operating schedule is determined. If a system is operable on days it is scheduled for use, it is counted as being available. If it is not available due to an aeration system forced outage and the DO falls below the established target, it is counted as "one mg/l DO deficit day." Data are reported monthly and accumulated throughout the year to determine the annual performance.

FORMULA: Deficit due to forced outage (mg-days/L) = [Target DO concentration (mg/L) – actual DO concentration during aeration system forced outage (mg/L) x [# days below target due to forced outage (days)]

SPONSOR: Janet Herrin
CONTACT: Chuck Bach

PROBLEM AREA

Aging aeration system components at some projects are failing now or have the potential to fail during future aeration seasons, potentially causing TVA to fail to meet DO target commitments in EIS for ROS. Failure to meet DO targets can adversely impact water quality and aquatic life.

DO Deficit in June was 0.01 due to an LOx supply valve being closed at Douglas. In August, DO was 0.62 due to a power transformer failure at Douglas. In September, DO was 1.40 due to blowers removal at Nottely.

Note: FY03 actual due to a forced outage at Nottely in August 2003.

IMPROVEMENT ACTION PLANS	DUE DATE
Procedure developed and being implemented by RvS staff that determines the status of DO monitoring and aeration system operation when RvS staff are notified by plant operators or HDCC staff that Hydro units are being returned to operation, especially after a prolonged outage.	Complete
Remove existing Cherokee LOx diffuser lines and replace with new lines	Complete
Replace existing Hiwassee LOx system header with new header and remote control	Complete
Additional oxygen capacity will be added at 6 existing sites.	Ongoing

BASIS

Aeration systems will be operated during the low DO season at 15 TVA dams in order to improve tailwater conditions below 16 projects. This period is site specific, but can range from mid-April to December. Specific DO targets are: 6 mg/L for cold water streams, and 4 mg/L for streams that have significant upstream nonpoint source pollution.

Aeration systems are designed to meet target DO levels under all but the most advesrse climatic and hydrologic conditions. Forced outages of aeration system components have a direct and major impact on TVA's ability to meet target DO levels. Planned operation and maintenance of TVA's aeration systems aims to restrict forced outages to hours instead of days and keep the DO deficit due to forced outages to 3 or less mg/L-days.

ATTACHMENT XII
Aeration Systems Availability

	Oct		Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep	
	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P	A	P
Apalachia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blue Ridge	26	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	30	30
Boone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chatuge	24	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22	31	31	31	31	30	30
Cherokee	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	13	31	31	31	31	30	30
Douglas	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.9	22	31	31	30.3	31	30	30
Fontana	11	11	30	30	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fort Loudoun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14	29.7	30	31	31	31	31	0	0
Hiwassee	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	31	31	31	31	30	30
Norris	31	31	30	30	8	8	0	0	0	0	0	0	0	0	0	0	9	9	31	31	31	31	30	30
Nottely	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	9	31	31	29.1	30
South Holston	31	31	30	30	8	8	0	0	0	0	0	0	0	0	0	0	0	0	31	31	31	31	30	30
Tims Ford	31	31	30	30	22	22	0	0	0	0	0	0	0	0	25	25	30	30	31	31	31	31	30	30
Watauga	30	30	30	30	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Watts Bar	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7.3	8	30	30	31	31	31	31	0	0
Monthly Total	250	250	150	150	50	50	0	0	0	0	0	0	0	0	46.3	47	157.6	158	288	288	311.3	312	269.1	270
Monthly % Available		100		100		100		100		100		100		100		98.5		99.7		100		99.8		99.7
FYTD Total	**250**	**250**	**400**	**400**	**450**	**450**	**450**	**450**	**450**	**450**	**450**	**450**	**450**	**450**	**496.3**	**497**	**653.9**	**655**	**941.9**	**943**	**1253.2**	**1255**	**1522.3**	**1525**
FYTD % Available		100		100		100		100		100		100		100		99.9		99.8		99.9		99.9		99.8
Monthly (DO deficit due		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.01		0.0		0.62		1.40
FYTD to forced outage)		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.0		0.01		0.01		0.63		2.03

Comments: June: DO deficit due to LOx valve closed at Douglas. One hour below target during unit generation.
August: DO deficit due to power transformer failure at Douglas over period of two days.
September: DO deficit due to removal of existing blowers at Nottely before interin LOx system put into operation.

ATTACHMENT XIII
Aeration Systems Outage Reports

Date	Plant	Problem	Reported By	Time Out	Time In	Comments
5/27	Watts Bar	Ran out of LO_x	Mira De.	1300	~~1435~~	-BOC was late getting to the tank, broke clutch on BOC tank.
					~~Hard~~	
5/30	WattsBar	Ran out of LOx	Chuck Parkins	1329	1615	- tank ran out
5/31	Watts Bar	"	L.D Bean	0200	~0500	tank empty
note:	there was no	~~data~~ DO deficit as a result of these outages. DO			stayed	above target of 4.0. CWD 6/30/04
6/23	Ftloudoun	Valves to 0% unable to reset	Bean			
6/27	Douglas	Valves to 0%	Bean		0838 6/28	Torrance reset it
6/28	Douglas	valves to 0%.	Bean	~2000	0800 6/29	called torrence@home
6/30	Ft Loudoun	valves to 0%.	Bean	0050 ~~2350~~	6/30 0600	MMD - I reset it
6/30	Douglas	valves to 0%.	Bean	0210	0800	torrance reset it
6/~~29~~ 29	DOUGLAS	Liquid supply valve closed	Proctor	2000	6/30 13:45	1 pair below target on 6/30 during unit generation
6/30	Douglas	DO probe not working ~~when it came back, it was below target~~	Mira	0615	7/1 1300	~~3 hours below target~~ 9 ways above target
7/15	Douglas	no communication w/ PAD, Power out? appear no box flag	Mike Daly	1645 ≈	7/16 1340	DO ok as of 0800 7/16, Hasn looking into it
7/18	FtLondon	Valves to 0%.	De	0230	7/18 0730	
7/30	Douglas	SWP 4, 5 & 6 out	Jim Dawson Lee	1500		
8/1	F. Loud	LOx out @ 1600	D. Shultz Watts	1600 8/1	1700-1800 8/1	Shultz reported 8/2 AM
8/9	Hiwassee	LO_x out @ 0900	M. Eiffe	0900 8/9	1100. 8/9	

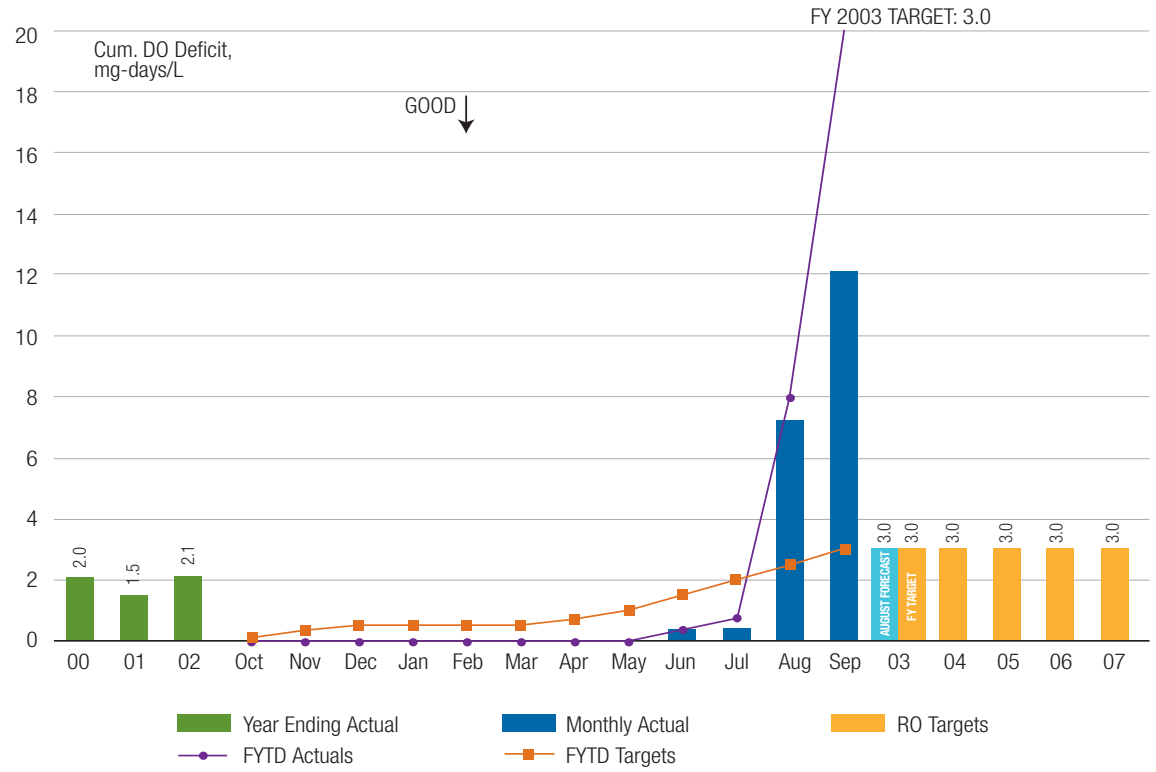
ATTACHMENT XIII
Aeration Systems Outage Reports

Date	Plant	Problem	Reported By	Time Out	Time In	Comments
8/10	Douglas	out of LO_x	M. Eifle	0840	1030	TW DO getting close to target...
8/12	Cherokee	out of LO_x	M. Eifle	0830		2 loads scheduled for today...
8/29	Douglas	LOST Transformer - NO Power	Lee Parris	0900	1500 8/30	DO deficit due to forced outage occurred over period of two days
8/7	Nottely	both blowers being replaced - interim O_2 system not operating	C. Goff	1100 EDT	1515 EDT 9/8	Blowers Back 9-24-04
9/9	Douglas	Problems w/ LOx Pad	L. Bean	1830		Proctor will be onsite 9/10 in the morning to work on
9/13	Douglas	LOX - out @ 1400 load scheduled for 7:40	A. L. Moore	2000	2130	
9/16	T. Ford	LOX - out	A. L. Moore	0315		BOC contacted and Delivery expected w/in 2 hrs.
9/22	Douglas	SWP # 5 BROKEN weld	C. M. Parkin	1000		
9/27	Douglas	LOX - 0% @ 2115. Shut lines to preserve Pressure	A. L. Moore	2115	0100 9/28	BOC contacted delivery should be here by 2300.
"	"	Re-opened lines w/ emerg. LOX		"	"	"

ATTACHMENT XIV

FY 2003 Performance Measure Chart

DISSOLVED OXYGEN DEFICIT DUE TO FORCED OUTAGE - SEPTEMBER 2003



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
FYTD Actuals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	8.0	20.1
FYTD Targets	1.0	0.3	0.5	0.5	0.5	0.5	0.7	1.0	1.5	2.0	2.5	3.0

DEFINITION: For each of the 15 dams with aeration systems installed (16 tailwaters actually benefit), a planned operating schedule is determined. If a system is operable on days it is scheduled for use, it is counted as being available. If it is not available due to an aeration system forced outage and the DO falls below the established target, it is counted as "one mg/l DO deficit day." Data are reported monthly and accumulated throughout the year to determine the annual performance.

FORMULA: Deficit due to forced outage (mg-days/L) = [Target DO concentration (mg/L) – actual DO concentration during aeration system forced outage (mg/L) x [# days below target due to forced outage (days)]

SPONSOR: Janet Herrin
CONTACT: Curt Goff, 632-4785

PROBLEM AREA

Revised DO deficit due to forced outage in August was 7.20 mg-days/L. This was due to one blower being out at Nottely as a result of a change in the configuration. FYTD through August was 7.97.

DO deficit due to forced outage in September was 12.08 mg-days/L due to the blower at Nottely still being out. FYTD is 20.05 mg-days/L.

IMPROVEMENT ACTION PLANS	DUE DATE

BASIS

Aeration systems will be operated during the low DO season at 15 TVA dams in order to improve tailwater conditions below 16 projects. This period is site specific, but can range from mid-April to December. DO targets are: 6 mg/L for cold water streams, and 4 mg/L for streams that have significant upstream nonpoint source pollution.

Aeration systems are designed to meet target DO levels under all but the most adverse climatic and hydrologic conditions. Forced outages of aeration system components have a direct and major impact on TVA's ability to meet target DO levels. Planned operation and maintenance of TVA's aeration systems aims to restrict forced outages to hours instead of days and keep the DO deficit due to forced outages to less than 10 Mg/L-days.

Tennessee Valley Authority | 400 W. Summit Hill Drive | Knoxville, Tennessee 37902 | **www.tva.com**